of abridgement, are reserved for the Philosophical Transactions, in which the paper will appear.

"Ordnance Survey Office,
Southampton, June 29, 1858.

"In the valuable communication by Archdeacon Pratt 'On the Effect of Local Attraction upon the Plumb-line at Stations on the English Arc of the Meridian between Dunnose and Burleigh Moor,' which is published in part 1. vol. cxlvi. of the Philosophical Transactions, the data for the calculation are taken from vols. ii. and iii. of the Trigonometrical Survey, which were published in 1811. Since the publication of those volumes the triangulation has been extended over the whole of the United Kingdom, new bases have been measured, and all the calculations have been revised; and as considerable errors have been detected in the distances used as data by Archdeacon Pratt, I directed Captain Clarke to substitute the correct distances in the formulæ used by the Archdeacon, and recompute the ellipticity and the amount of the local attraction at the several stations. The accompanying paper contains the results; and you will see that we have simply made the numerical computations without presuming to alter the formulæ employed; in fact I have considered it almost a duty on our part to supply the labour of recomputation, the necessity for which was caused by the errors in our first published volumes."

"HENRY JAMES."

"*G. G. Stokes, Esq., Sec. R.S.*"

November 30, 1858.

ANNIVERSARY MEETING.

The LORD WROTTESLEY, President, in the Chair.

Mr. J. G. Jeffreys reported, on the part of the Auditors of the Treasurer's Accounts, that the total receipts during the past year, including a balance of £27 5*s.* 8*d.* in the hands of the Treasurer, amounted to £3864 15*s.* 3*d.*; and the total expenditure during the same period, including a balance of £47 9*s.* due to the Society's Bankers, amounted to £4048 1*s.* 11*d.*, leaving a balance due to the Treasurer of £183 6*s.* 8*d.*

The thanks of the Society were voted to the Treasurer and Auditors.

The Secretary read the following lists.

Fellows deceased since the last Anniversary.

On the Home List.

William Ayrton, Esq.
Rear Admiral Sir Francis Beaufort, K.C.B.
Robert Brown, Esq., D.C.L.
Edward Bury, Esq.
Alexander Caldcleugh, Esq.
Joseph Carne, Esq.
Sir Philip Crampton, Bart.
Edmund Davy, Esq.
Rev. Richard Dixon, M.A.
Sir James Fellowes, M.D.
Edward Griffith, Esq.
Thomas Charles Harrison, Esq.
Thomas Legh, Esq.
Sir James MacGrigor, Bart.
Sir George Magrath, K.H., M.D.
Ebenezer Fuller Maitland, Esq.
Thomas Lister Parker, Esq.
Hugh Lee Pattinson, Esq.
Very Rev. George Peacock, Dean of Ely.
Major-General Sir William Reid, K.C.B.
John Forbes Royle, M.D.
Richard Horsman Solly, Esq.
Thomas Tooke, Esq.
Benjamin Travers, Esq.
Charles Hampden Turner, Esq.
Dawson Turner, Esq.
Henry Warburton, Esq.

On the Foreign List.

Johannes Müller.

Withdrawn from the Society.

George Hunsley Fielding, Esq.

Fellows elected since the last Anniversary.

Thomas Graham Balfour, M.D.
Edward Mounier Boxer, Captain R.A.
Frederick Currey, Esq.
David Forbes, Esq.
Alfred Baring Garrod, M.D.
William Henry Harvey, M.D.
The Rev. Samuel Haughton.
Henry Hennessy, Esq.
David Livingstone, LL.D.
John Lubbock, Esq.
Right Hon. Sir John Pakington, Bart.
Henry Darwin Rogers, LL.D.
William Scovell Savory, Esq., M.B.
Warington Wilkinson Smyth, Esq.
The Right Hon. James, Lord Talbot de Malahide.
Lieut.-Col. Andrew Scott Waugh, B.E.
Thomas Williams, M.D.

Foreign Members elected.

Robert W. Bunsen.
Louis Poinsot.
Carl Theodor von Siebold.

The President then addressed the Society as follows:—

GENTLEMEN,

IN addressing you for the last time from this Chair, which by your favour I have now occupied for a period of four years, it affords me great gratification to be able to announce that all those measures which were rendered necessary by our removal to this site, are now completed, and we meet in an apartment which may be truly said to be worthy of a Society which for near 200 years has taken the lead in fostering a spirit of investigation into the laws of nature, and thus promoting the best interests of its country and of mankind.

I rejoice that our walls are once more adorned by pictures of some of the most eminent of the many distinguished men, who by their lives and discoveries have left an imperishable name to posterity, and shed a halo of glory over the whole human race. Even as amidst the ruins of Iona our great moralist felt his religious enthusiasm powerfully aroused, so may the sight of these portraits kindle in us and our successors an earnest desire to emulate the virtues of those whom they represent—that spirit of persevering research which achieved such brilliant success—that regard for truth which deems no sacrifice too great when her interests are at stake—that modesty, the never-failing companion of genius, which, slightly regarding results attained, is almost overpowered by the sense of what remains to be accomplished. When we look at these memorials of our predecessors, may we feel as the Romans of old, when they beheld the statues of their ancestors; they declared, "Cum majorum imagines intuerentur, vehementissime sibi animum ad virtutem accendi;" and yet, to use the words of the Grecian orator, Παισὶ δ' αν ἢ ἀδελφοῖς ὁρῶ μέγαν τὸν ἀγῶνα. Great is the competition indeed, and few are the champions worthy to contend.

In a former Address I expressed a hope that the late Government would send an Expedition to the mouth of the Mackenzie River to continue those magnetical observations, which had been so perseveringly and successfully carried out by Capt. Maguire, and from which expedition important accessions to our knowledge of the magnetical laws were not unreasonably expected; but unhappily these hopes have not been realized. Our disappointment may possibly be traced, partly to the dislike which seems to prevail to anything

which can be designated as a renewal of Arctic voyages, and partly to the want of a due appreciation of the value of the researches proposed to be undertaken. On the objections arising out of this antipathy to Polar expeditions, I have said so much on a former occasion, that I will not again advert to them, further than to observe that there was no ground for believing that the dangers to which Arctic voyagers are sometimes, though rarely, exposed, would have been encountered in this expedition; and doubtless there were many gallant hearts eager to face any amount of peril in so worthy a cause. As to the second point, viz. the want of a due appreciation of the researches themselves, I think it impossible to believe that any one of average capacity and discernment would undervalue the importance of prosecuting inquiries of this character, were he familiarly acquainted with the history of scientific discovery. If our leading statesmen and legislators had perused with the same attention the records of the progress of science as many of them have devoted to the historical memorials of the two great nations of antiquity, can it be doubted that they would view these questions in a far different spirit?

When two powerful nations connected together by the tie of a common origin and a common language were informed that messages of mutual congratulation between their respective rulers had been transmitted by the electrical current, beneath more than 2000 miles of the deep waters of the vast Western Ocean, and that the two great continents of the globe had been brought, as it were, within speaking distance, a general sensation of delight pervaded their inhabitants, and there was no want of appreciation of such results of scientific research; but it were well for Science and for the cause of future discovery, if any great proportion of those who shared in this joy had been able to trace the slow and gradual processes by which such triumphs of human genius had been finally won. I have no hesitation in speaking of this wondrous achievement as a success, for it has been clearly shown that the work can be performed whenever public spirit and zeal shall supply the necessary funds.

There is a lesson then which many men have yet to learn, and it is most desirable that those especially, to whom the destinies of nations are given in charge, should learn it—a lesson which I may express in the words of a Report of the Parliamentary Committee

of the British Association, viz. "The most abstract scientific investigations have often led to most useful industrial applications; and observations and experiments, seemingly trivial and likely to lead to no useful result, have sometimes, after the lapse of years, been elaborated into discoveries which do honour to human nature."

Let us by way of illustration sketch some of the countless researches which preceded the invention of the Electric Telegraph. In 1729 Grey discovered that electricity could be transmitted through conductors to a distance. In 1747 it was transmitted through several miles of wire. In 1753 an anonymous writer in the 'Scots' Magazine' first suggested the idea of an electric telegraph. In 1800 the voltaic battery was invented. In 1802 it was discovered that the earth might be substituted for the return wire of a voltaic circuit. In 1820 Oersted discovered the mutual action of voltaic conductors and magnets, the foundation of the science of Electro-magnetism. In 1820, also, Schwiegger invented the electro-magnetic multiplier. In 1822 Ampère developed the laws of Electro-magnetism, and discovered many new facts, and Arago detected the action of a voltaic current on soft iron. In 1827 Ohm eliminated the laws of the voltaic circuit. In 1832 began the brilliant researches of Faraday, in which he discovered and enunciated the laws of voltaic and magneto-electric induction. In 1834 Wheatstone invented and practically applied a method of measuring the velocity of electricity in metallic wires. In 1835 Gauss and Weber employed their electric battery in establishing a communication between the Observatory of Göttingen and the University; and in July 1837 Wheatstone first tried his electric telegraph on the line of the London and Birmingham Railway. During all this period the voltaic battery was gradually improved and its powers vastly augmented by Daniell and Grove.

Again, the progress of Chemistry during the last sixty years affords abundant evidence of the advantages derived from the pursuits of abstract science, when viewed simply in their bearing upon the comfort and convenience of mankind.

At the close of the last century, the Swedish chemist, Scheele, made a series of experiments on the black oxide of manganese. To some this might have seemed a very unprofitable waste of time; but what was the result? Chlorine was discovered, a substance of the greatest importance in the arts. Berthollet, finding that this gas

changed the colour of the corks of the bottles in which it was confined, suggested its employment as a bleaching agent. This suggestion, successfully carried out by Tennant, produced a complete revolution in the staple trade of Manchester and Glasgow. The operations of the bleacher were shortened from several months to as many hours. The discovery of iodine was the result of a not very promising examination of the refuse of kelp liquors; and a laborious train of investigation into the laws of decomposition gave us chloroform. But what inestimable benefits have accrued to mankind from these discoveries! I need hardly speak of the vast alleviation of human suffering which is due to the guarded use of the latter substance; and the former, in addition to its medicinal value, is the basis of photography, one of the most beautiful and curious of modern arts, which not only adds to our rational enjoyments, but is extensively used in scientific researches, and ministers efficiently to the useful purposes of life.

Then, again, Professor Owen astonished his audience at Leeds, by relating how much agricultural wealth had been derived from the proper application of a single once-neglected fossil.

The hopes which I at one time entertained that the Government of Victoria would erect at Melbourne a four-foot reflector for the observation of the Southern Nebulæ, have not hitherto been fulfilled. The General Committee of the British Association have voted a sum of £200 towards carrying out the project, on condition that the remainder of the funds shall be supplied by the local government; and this course they have taken in testimony of the interest which they feel in the proposed measure, and of their desire to see it carried fully into effect. Our posterity will have just ground of complaint if the task be much longer postponed of surveying and delineating the forms and peculiarities of these southern nebulæ with instrumental means, equal to the work, and capable of supplementing what has been done and is now doing for the nebulæ visible in our own latitudes by the magnificent instrument, for which Science is indebted to your late President. The possession by this country of vast colonies in various parts of the globe, offering facilities for the erection of observatories and instruments for pursuing our researches into nature's laws under every variety of climate and position on the earth's surface, does seem to impose on a great and

thriving nation some obligation to utilize these advantages for the welfare of mankind at large. Truly something besides material gold is to be had there for the seeking; the precious ores of intellectual progress may there also be culled and stored away.

The history of the progress of astronomical science has already disclosed both the evil effects of neglecting these duties, and the benefits which are likely to accrue when they are properly fulfilled. When, in 1819, Encke computed the orbit of the comet of short period, which justly bears his honoured name, and announced its return in 1822, that return would not have been observed had not the zeal of a private individual, Sir Thomas Brisbane, established an observatory at Paramatta in Australia, where, and where alone, its reappearance was noted. Subsequently, the observatory at the Cape of Good Hope was established; but for many years, both there and in Australia, the instrumental means provided for the observation of comets were inadequate to the due discharge of the task. Now it is well known that the motions of the comet of Encke first suggested to astronomers the probability of the existence of some highly attenuated medium or ether pervading the planetary spaces, in which both planets and comets perform their revolutions. Every succeeding return of this most interesting though diminutive body has tended to confirm and strengthen that probability, which has now well nigh, if not entirely, assumed the proportions of a physical fact. But on each succeeding return of this wandering visitor, until 1855, the distinguished veteran, who watches its motions with all the interest and anxiety displayed by a fond parent towards a favourite child, has had cause to deplore the deficiency of the instruments in the Southern Hemisphere, to which the duty is necessarily assigned of continuing the observations after the comet has ceased to be visible in these latitudes. Before 1855, however, a more powerful equatoreal had been supplied to Mr. Maclear, the able astronomer at the Cape; and now, to use the words of Encke himself in his letter to the Astronomer Royal,—"In the year 1855, thanks to the skill of Mr. Maclear, and the beautiful $8\frac{1}{2}$-foot equatoreal with wire micrometer, the observations are perfectly on a level with the European, which I take the opportunity of begging [you] to make known to Mr. Maclear with my best thanks. It is a real pleasure now constantly to see that the comet is observed at every return with an

accuracy, which, in the year 1819, there was no possibility of expecting." Now, it appears that these observations of 1855 fully confirmed the fact of the acceleration of the comet's mean motion, so often observed before; but they have done more than this, for they have been so well made, that Encke was enabled by their means to correct the elements of the orbit, and calculate an ephemeris for the return of the comet this year, taking into account the perturbations of Jupiter, with such consummate accuracy, that on the first evening on which, through the absence of moonlight, there was a hope of finding it, which was on the 7th of August, it was actually detected during the first half-hour's search in the place given by calculation, though presenting to the eye only a faint diffused nebulous mass of about one minute in diameter. Now, if the existence of this ether, or attenuated atmosphere, pervading the planetary spaces, should be conclusively established, of which there is now scarcely any doubt, it is a fact of the utmost physical importance. We may not indeed in the present state of science be able to foresee all the consequences which may flow from its establishment; but we know enough to perceive that the question has an important bearing upon several interesting modern speculations. The suggestion of this resisting medium is only one of many important services which this diminutive but most interesting comet has rendered to astronomical science, and will doubtless still continue to render. Mr. Maclear's equatoreal will now be turned to profitable account in following up the fine comet of Donati, which has just escaped from our view to present itself, but shorn of most of its former splendour, to the expectant gaze of southern astronomers. Those who had the good fortune to observe this comet on the night on which it approached Arcturus so nearly, will not easily forget the spectacle it then presented.

You are well aware that it was in our Colonies also that many of the magnetical observatories were established, in which for several years hourly observations were made of the three magnetical elements; and it may be confidently affirmed that from these observations most valuable results have been deduced, to which, however, as they were to some extent described by me on a former occasion, I will not further allude, than to inform you that in the opinion of your Council the time has now arrived, in which it is most expedient that

these observatories should be again established for a limited period, furnished with instruments from Kew, embracing all modern improvements. The propriety of pursuing this course has been carefully investigated by a Joint Committee of this Society and the British Association, of which Sir John Herschel acted as Chairman. They have reported strongly in its favour, and an application has accordingly been made to the Government by Prof. Owen, as President of the British Association, and myself, urging the re-establishment of these observatories at four stations, viz. Newfoundland, Vancouver's Island, the Falkland Isles, and at Pekin or some adjacent station. I cannot but add the earnest expression of my hope that the Government will be induced to regard with favour this proposal, for I well know that all the distinguished men who have made magnetical science their peculiar study, including the honoured name of Humboldt, are most earnest in desiring it. It would require more time than I can afford to bestow on the subject, were I to attempt even to hint at all the benefits which might flow from the complete elimination and elucidation of the magnetical laws; but the construction of correct and complete charts, showing the variation and the isodynamical and isoclinal lines at given epochs, is alone an object of transcendent importance to commerce and navigation. To this must be added the accurate establishment of the data on which are founded the methods adopted for ascertaining and correcting the deviations of the compass in iron ships; and besides, we must always bear in mind that the result of modern speculations seems to show that all the so-called imponderable agents, heat, light, electricity, and magnetism, are intimately connected by mysterious links; every accession to our knowledge of one has therefore an important bearing on the elucidation of all the others.

It would appear from a communication which has been received by your Council, that it has been in contemplation by the Government to erect, on the unoccupied site to the north of Burlington House, an office for the Commissioners of Patents. This is a mode of employing the large surplus income which is now derived from patent fees, to which no objection can be reasonably made; but the whole subject of the working of the patent laws must at no very distant date again undergo a searching investigation. It can never be tolerated

that inventors, to whom we owe such inestimable accessions to the conveniences and luxuries of life, should be subject to a tax peculiar to their class alone; and this must be the effect of the present law so long as fees are received from the patentees exceeding the amount which may be reasonably demanded for purposes in which they have themselves a direct interest, and the surplus carried to the account of the public Exchequer. At the same time I cannot but think that a small sum in addition might justly be required from every grantee of a privilege of this kind, to be carried to a fund for the promotion of the researches of abstract science; for assuredly there are none who derive more direct benefit from such investigations than those from whom the payment would be demanded; and that class have, and more especially in a country like this, opportunities of turning their talents to pecuniary account, which are altogether denied to the cultivator of abstract science, who forms his nest only to be seized by some more fortunate occupier, coming in like the bird in the fable, and appropriating to his own benefit the severe and long-protracted labours of the skilful and painstaking builder.

On reviewing once more the position of Science in this country, I find that the voluntary or independent system has been carried very far indeed. That is, a great many Societies have at various periods, from 1663, the date of this the most ancient, to the present time, been successively founded for the promotion and encouragement of science. Those who compose these various associations pay for the honour of enrolling their names as members, sums which must be considered large in reference to the means of some of the contributors; and many of those members in addition devote a considerable portion of their valuable time to scientific researches. These Societies, though contributing so much to the public weal, are yet for the most part entirely unrecognized by the Government, and, with certain trifling exceptions, receive no kind of public aid in prosecuting their valuable labours; but, on the other hand, by a kind of hap-hazard arrangement, strongly characteristic of our national character, the Government has from time to time organized various bodies, which, though with few exceptions not recognized by any act of the legislature, are yet invested to a certain extent with an official character, and obtain greater consideration from the Government in consequence. Such, for example, are the

Board of the Trustees of the British Museum ; the Board of Visitors of the Royal Observatory of Greenwich, which has an official connexion with the Board of Admiralty ; the various officers to whom the management of matters connected with science or art is committed by the Council of Education, Board of Trade, or Military or Naval authorities. Now if we contrast this system of ours with that of our neighbours in France and some other continental states, we shall find that there are marked and striking differences between them. In France there is the Institute, the members of which not only do not pay out of their own resources for the honour they enjoy, but are invested with high privileges and great official consideration, and receive stipends from the State, at the price no doubt of an amount of Government interference with their proceedings which our countrymen might probably hesitate to submit to. I believe that in France the members of the Institute, as such, are regularly consulted on the important scientific questions which must present themselves for solution from time to time in the course of civil and military administration. In England, on the other hand, the various voluntary or private Societies established for the promotion of science have never been recognized as advisers of the Government, or consulted as a rule ; though undoubtedly the Councils of this and other Societies have been often applied to for advice, and more frequently perhaps of late years than formerly ; but the various Boards and officers above referred to are not only invariably consulted on those matters which are consigned to their management, but there are few instances on record in which their advice has been neglected, or the measures recommended by them have failed to be carried into effect.

In instituting any comparison of the relative merits of these two modes of proceeding, it is clear that, irrespective of the results obtained, the decision of the question as to which is to be preferred, must depend greatly on the mode by which the referees of the Executive in the two countries are appointed ; for it may be fairly assumed that both contain men well qualified, both by their extensive attainments and natural and acquired abilities, to give good advice to their respective Governments. Now the French Institute undoubtedly comprehends most able and highly distinguished men, enjoying an established and world-wide reputation, and well qualified to give sound advice to their Government on questions of science. This is

undoubtedly true, though it may be equally true that there are circumstances in the working of the French system, dependent partly on the immense value of the privileges conferred by the election, which have a tendency to arrest the wholesome progress of science in that country. In England, so far as an experience of nearly forty years can enable me to form an opinion, I should say that there is great impartiality and discrimination exhibited in the selection of men to fill high posts in the various Scientific Societies there established, and I apprehend there are few instances in which meritorious and successful cultivators of the various departments of science, if resident in the metropolis, have failed in obtaining their share in the government and administration of those learned bodies. The constitution of the Board of Visitors of the Greenwich Observatory also is worthy of all praise. It has contributed in some degree doubtless to raise that establishment to the high point of eminence which it now deservedly occupies; and that constitution has called forth the warm eulogiums of the veteran French astronomer Biot, than whom there can be few more competent judges. On the other hand, the mode of appointing the Trustees of the British Museum is defective in the extreme. They are nominally elected by the Trustees themselves, but the Trustees, who have been themselves elected, are by an absurd regulation excluded from the body of electors. The officers of the Council of Education and the Board of Trade, and the Military and Naval Boards are appointed by the Government or Military authorities, and the nominations are thus subject to all the incidents of appointments of this class.

The blots in our system seem to be, first, that there is a great want of combined action between the various communities representing Science;—an evil, which might possibly be remedied by some joint representation of the whole; and secondly, that the Societies instituted for the promotion of the various branches of science, though containing among their members and governing bodies those men who have been impartially selected as pre-eminent in their various walks, are not officially recognized in any way as authorities, or appealed to except occasionally and by accident, whenever some member of the Administration may happen to perceive that their counsel might advance the object in view, and be profitable to the State. Moreover, it seems never to have occurred either to the

Government or Parliament, that the materials exist out of which a Board may be formed which might be expected to give wholesome advice on scientific questions, take on themselves a share of the Government responsibility, and save the country from the bad consequences which now flow either from neglecting to take counsel, or from the careless and indeterminate way in which it is sometimes sought and obtained.

There are other points connected with the important questions to which I have shortly adverted, for which I must refer you to the twelve resolutions of your Council of January 1857; and also to the Report of the Parliamentary Committee to the British Association of 1855, already referred to, in which the subject is discussed and examined.

I anticipate much advantage to science from the circumstance that His Royal Highness The Prince Consort has consented to accept the Presidency of the British Association. Science has no need of a Patron in the ordinary sense of that term; but her interests are much advanced when those who occupy exalted stations, and are endowed with great qualities of mind and heart, are induced to take part in her councils, and become cognizant of the character, views, and requirements of the most distinguished of her cultivators.

It would appear from the Report of that truly zealous and indefatigable officer of the Society, your Treasurer, dated October 1857, that we had then a considerable excess of income over our average ordinary expenditure, that probably we should shortly be in the receipt of annual sums in respect of the Stevenson Bequest, and that on the demise of the tenant for life, we should come into possession of the Handley legacy. This therefore renders it probable that we shall have a clear balance at the end of each year; and in the course of time, as annuitants die and the legacies come into possession, that balance will be augmented.

Now since the date of this Report, we agreed to appropriate a sum of £250 towards the formation of a MS. Catalogue of Scientific Memoirs, a grant which will probably be yearly renewed until that work is completed; and there can be no doubt that the cost of the printing and publishing the Transactions is increasing and will still increase; but still we must look forward to a period which may not be tardy in arriving, when we shall have a larger annual surplus to

dispose of. I quite agree with our Treasurer, that it deserves consideration whether a more advantageous employment might not be found for our surplus income, "more beneficial to science and to the Society itself, than that of continuing to increase the accumulated funds." Dr. Wollaston would probably have supported these views; for in his celebrated letter on establishing the Donation Fund, read to the Council on the 11th of December, 1828, he says, "I hereby enjoin the President, Council, and Fellows not to hoard the dividends parsimoniously, but expend them liberally, and as nearly as may be annually."

Now there are some who think that we should look forward to a time when the payment of annual subscriptions should be discontinued. I cannot subscribe to this opinion. It is true, that there are men who by natural talent, by incredible perseverance, self-devotion and industry, have risen, as it were, from the ranks of science, to whom the large payments exacted from members are a serious inconvenience and an obstruction to their obtaining those honours which they have justly earned by the labours of a well-spent youth. Let such men be excused; but I cannot comprehend on what principle we should refuse to receive pecuniary contributions for a most worthy object, from those who are not unwilling and are perfectly able to pay them in exchange for the honours and many other advantages which their Fellowship confers upon them. There may be some, again, who imagine that there will be some difficulty in discovering a mode of expending this anticipated surplus which is likely to meet with general approval. I cannot believe it. There are many works which cannot be written; many researches, experiments, and observations which cannot be made, reduced or published; many voyages and travels that cannot be undertaken because the necessary funds are not to be had. Moreover, there is a mode of applying a part of these accumulations, which has suggested itself to some of the members of your Council, to which I will allude very briefly. Your Secretaries are always chosen from among the most distinguished of your Fellows. They are generally men who are occupied in professional and professorial duties which embrace a very large portion of their time; and it is their precious leisure hours only which they can devote to your service; hours, which when not given to necessary relaxation, they would

probably employ in scientific research or private study. It might be truly said that no payment that we can afford to make could be a sufficient return for such services as they render under such circumstances. It is not intended however, doubtless, that the full value should be given. It is perhaps right that the honour conferred by the appointment should constitute a part of the reward, but the remaining or pecuniary part may be so trifling as necessarily to exclude from your service some who cannot afford to accept office on terms so inadequate.

And now, in conclusion, I bid you farewell, and I do so with a most cordial and heartfelt expression of gratitude for the unvaried kindness and confidence which I have ever received from you. The transaction of your business has necessarily brought me into frequent and most confidential intercourse with your officers, and I can truly say that I have ever received from them the most effective support and assistance; they have given me sound advice without obtruding it, and have brought to the conduct and administration of your affairs an amount of talent, zeal for your interests, and varied acquirements, which may be equalled, but which it will be very difficult indeed to surpass. The intimate relations and unreserved confidence which have ever existed between us have created a friendship which I hope may endure as long as my life is prolonged. The members of your Council are most assiduous in their attendance; and the affairs of the Society are by them discussed and transacted in a manner which has always excited in me great admiration.

In resigning the Chair I can feel no distrust as to the future, when I reflect that I shall probably be succeeded by one whose private worth, scientific attainments, and intimate knowledge of the business of this Society are universally admitted, and in whose hands your interests and reputation are safe. I shall account him happy if he be elected to fill a post, so honourable in my estimation, that the recollection that I have once occupied it will be one of the chief consolations of my latter years.

The Copley Medal has been awarded to Sir Charles Lyell for those original researches and comprehensive generalizations which have mainly contributed to raise the study of geology to that high scientific position which it now holds, and to maintain for the English

school of geologists that eminent rank which has hitherto been accorded to it.

A quarter of a century has now just elapsed since the Royal Medal was awarded to Sir Charles Lyell for his 'Principles of Geology.'

It was his good fortune to be associated in his earliest years with those from whom he imbibed a love of Natural History, and who fostered those habits of accurate observation, the successful application of which to geological problems is one of the prominent features of his scientific writings. This it was that gave so much value and promise to his first labours on the geology of the marls and freshwater formations of Angus, his native district; that enabled him to appreciate to the full, the bearings, not only of palæontology (the importance of which had been already recognized), but also of a large class of facts, of almost equal value in relation to the philosophy of geology, conducting him through a series of researches, the merit of originating which is wholly his own:—I allude to the permanence or mutability of animal and vegetable forms, to their reciprocal action, and to the laws which govern their reproduction and dispersion; and we hence owe to him both the enunciation and the demonstration of the doctrine, that the history of many ancient geographical changes and geological phenomena is only to be arrived at after a careful study of the present distribution of organic beings.

The same line of research led Sir C. Lyell, in conjunction with M. Deshayes, to that method of classifying strata, and hence of comparing formations, by the relative proportions of living organisms they contain,—a method which has proved of such eminent service to geologists. By its aid, and after untiring diligence in collecting, and equal perseverance and sagacity in comparing the results of his own and other collections, with those in the various museums of Europe and America, he has not only largely contributed to classify the tertiary rocks of both continents, but has further given us the first clear idea of the relations of modern strata separated by the great valley of the Atlantic Ocean.

In immediate connexion with these inquiries, and no doubt directly originating in his mind from that principle to which he has steadfastly adhered, of endeavouring to account for past changes

by a reference to existing causes, are his philosophical views of the relations of climate to the former extension of land and water, which have resulted in doctrines of the highest importance. This principle, long disputed, is now so far recognized, that no cautious naturalist declares himself satisfied with the explanation of a geological phenomenon except he can test or illustrate it by agencies now in operation. It is true that Hutton and Playfair originated the hypothesis that causes such as are now in action would account for all we see on the surface of the globe; but we owe to Sir Charles Lyell that careful collection of facts and that sagacious reasoning, by which this hypothesis has been raised to the rank of a well-grounded theory.

We cannot overrate the services which he has rendered by his investigations into the dynamics of geology; nor the importance of his memoirs on the risings and subsidences of land, and their incessant fluctuations, on the means, extent, and effects of the distribution of sediments, and the changes wrought on these by metamorphic action, and on the amount of denudation which all formations have undergone. These, and a vast number of subsidiary phenomena, have led him by an elaborate train of reasoning, to gauge boldly the depth of detrition to which our planet has been subjected, by the miles of sedimentary rocks accumulated on its surface; and to those startling speculations on the antiquity of the earth's crust, which, having survived the ridicule and contempt of many critics, and the rejection by more as visionary, are now becoming accepted as fundamental truths.

The geology of volcanos in its widest sense presents another great field for observation and reflection, to which Sir C. Lyell has assiduously applied himself; and here I can do no more than allude to his discoveries and discussions on "craters of elevation," the amount of denudation which volcanic cones have sustained, their valleys and dykes, and the inclination of their lava beds, as all of the greatest importance; especially, however, referring to the results of his recent studies of Etna, because they afford the clearest demonstration of the genesis and internal structure of volcanic mountains.

There is indeed no department of geology,—from the Silurian strata to the mud now depositing on our coasts and in our lakes—

from the Plutonic rocks to the lavas not yet cooled on the flanks of Vesuvius—that Sir Charles has not diligently explored, from Scandinavia to Sicily and the Canaries, and from Canada to the Gulf of Florida; he has sought to develop the history of coal by observations on the ancient carboniferous strata of both hemispheres, on the superficial peats of England, and on the vegetable swamps of the United States; tracing at the same time the coasts of the former glacial ocean, by the boulders that are the landmarks of its ancient shores, and by the broken shells thrown up on its beach.

In thus recognizing those attainments and powers of generalization which have for the first time brought so many branches of science into close connexion, and have placed Sir Charles Lyell foremost in the rank of the founders of the Philosophy of Geology, the Council of the Royal Society do not overlook the scientific value of the narratives of his American travels, the merits of his style, and the evidences of careful attention to those details of scientific writing which have rendered his works so clear and attractive. To these qualities he is greatly indebted for the influence he has exercised, not only in attracting students to follow his steps, and in inducing proficients in geology to reflect, but in advancing the whole domain of natural science; and hence he may justly claim from botanists and zoologists as cordial a tribute of admiration and gratitude for services rendered to their branches of science, as has ever been tendered to him by his brother geologists.

Sir Charles Lyell,

Accept this Medal, the highest reward we can bestow, in token of our due appreciation of a series of scientific researches, prolonged through several years, and prosecuted with very great ability and perseverance; and in wishing you long life and health to enjoy your well-earned honours, allow me to add that my happiness in bestowing them is enhanced by the reflection that I am conferring pleasure on one whose friendship I have now enjoyed for a period of more than forty years.

The Rumford Medal has been awarded to M. Jamin, Professor at the École Polytechnique of Paris, for his various experimental researches on Light.

M. Jamin has for many years been engaged in a series of important experimental researches in optics. One of his earliest labours relates to metallic reflexion. Malus found that metals form an exception to the general rule of polarizing light at a proper angle of incidence, though they do produce a partial polarization. We owe to Sir David Brewster the discovery of the curious modifications which reflexion at the surface of a metal is capable of producing on polarized light. The theory of undulations enables us to form a clear idea of the nature of the light so reflected, and shows, moreover, that in order to know everything about the reflected light, whatever be the nature of the incident light, it is sufficient to know for each angle of incidence three things; the proportion in which light polarized in each of the two principal planes is reflected, and the difference of phase produced by reflexion. The subject of metallic reflexion had afterwards been considered in its bearings on certain phenomena; but there were still wanting, on the one hand, an extensive series of careful measures of the three quantities above mentioned, taken for various incidences and for different metals; and on the other, a theory which should embrace them all, expressing them as functions of the angle of incidence by formulæ containing a certain number of constants depending on the nature of the metal.

M. Jamin applied himself to supply the first of these desiderata; and in an important paper published in the 'Annales de Chimie' for 1847, he has given tables containing the results of careful measures taken on several metals. The methods employed cannot here be described, but they exhibited in a remarkable manner a combination of experimental care and skill with a thorough acquaintance with the principles of the theory of undulations. It belongs to the physical mathematician to supply the requisite formulæ, which, while differing from mere empirical formulæ in being deduced from a physical theory, shall accurately represent the results of observation.

The subject of metallic reflexion had engaged the attention of mathematicians, and M. Cauchy had arrived at certain formulæ to express everything relating to the metallic reflexion of homogeneous light. These formulæ contain only two arbitrary constants, depending upon the nature of the metal, and capable of being determined by the observation of two angles. M. Jamin himself has compared

the results of his observations with the formulæ of M. Cauchy; and the accordance of the calculated and observed numbers is striking in the highest degree.

Another highly important memoir of M. Jamin, read before the Academy of Sciences, and published in the 'Annales de Chimie' for 1850, relates to the reflexion of light at the surface of transparent media. According to the formulæ of Fresnel, when light polarized perpendicularly to the plane of incidence is incident on such a medium, and the angle of incidence is increased from 0° to 90°, at a certain angle (the polarizing angle) the reflected light vanishes, and in passing through this angle the reflected vibration changes sign, or in other words, the phase is changed by half an undulation. It had already been recognized, that in the case of very highly refracting substances these results differ very sensibly from the phenomena actually observed; and by observations on Newton's rings when formed between a glass lens and a plate of diamond, Mr. Airy long ago showed that in the case of diamond the light does not wholly vanish at the polarizing angle, and that in passing through this angle, on increasing the angle of incidence, a continuous but rapid retardation of phase takes place, amounting to a quantity sensibly equal to half an undulation, while the angle of incidence is increased a few degrees. But except in the case of substances of very high refractive power, it had been supposed that Fresnel's formulæ sensibly represented the phenomena observed. Such was the state of the subject when M. Jamin commenced a series of most elaborate experimental researches, which resulted in showing that the phenomena above mentioned, instead of being confined to a few of the most highly refractive bodies, were of almost universal occurrence, though for most bodies the only sensible changes of phase were crowded within a small range of incidence, and the quantity of light reflected at the minimum was very small. A very striking result of these researches was, that the change of phase had not always the same sign. It appeared that for bodies having a higher refractive index than about 1·46, the change was of the same sign as in the case of metals, while for bodies having a refractive index much lower it was the opposite. Thus the case of no reflexion at a particular angle, accompanied by an abrupt change of phase amounting to half an undulation, or, as in this special instance it may be more simply

considered, a change of sign in the reflected vibration in passing through zero, proves to be merely the separating case between two opposite classes of phenomena. M. Jamin has further compared the results of his observations with the formulæ of M. Cauchy, with which they manifest a striking agreement. These formulæ contain, besides the index of refraction, a second constant, which M. Jamin calls the *coefficient of ellipticity*, which must be determined for each substance in particular.

In a later memoir published in the 'Annales de Chimie' for 1851, M. Jamin has extended the same results to liquids, which offer several examples of what had been already perceived in the case of solids; that though if bodies be arranged in order according to their decreasing refractive indices, the coefficient of ellipticity *on the whole* decreases, and after vanishing increases again negatively, yet there exist exceptions enough to this rule to show that the coefficient of ellipticity cannot be a function merely of the refractive index, but must depend also upon the nature of the body.

The preceding volume of the same work contains two other memoirs by M. Jamin; one on the double refraction of quartz, the other on total internal reflexion; both affording new proofs of his skill and sagacity.

In a paper published in the 'Annales de Chimie' for 1852, M. Jamin has shown the influence on the phenomenon of Newton's rings of the reflexion of light polarized in the plane of incidence in the neighbourhood of the angle of maximum polarization, and of the changes of phase which it then undergoes. The paper contains also other results relating to the rings which are worthy of notice, not belonging specially to what takes place near the angle of maximum polarization.

There are other papers of M. Jamin's to which time will not permit me to refer; but in the year 1856 he brought before the French Academy an instrument, in which he utilized, in a most happy manner, the fringes which had long before been observed as arising from the interference of some of the many portions into which light is divided by reflexion at the surfaces of two plates of glass of equal thickness. This instrument constitutes an interference-refractometer which unites delicacy with singular convenience.

In the same communication the author has given some highly

curious applications of his instrument to the obtaining of qualitative results, having applied it to show the concentration of the solution of an iron salt produced by the attraction of a magnet, the state of a solution about a growing crystal, &c. The use of the instrument is, however, by no means confined to qualitative observations; and in two memoirs published last year in the 'Annales de Chimie,' the author has successfully determined by its means the refracting power of the vapour of water, and the influence of even a moderate pressure in altering the refractive power of water in the liquid state.

MONS. JAMIN,

Accept this token of the great value which we attach to your extensive series of experimental researches on Light.

A Royal Medal has been awarded to Mr. Albany Hancock for his numerous and varied contributions to Comparative Anatomy and Physiology, but more especially for his "Researches on the Organization of the *Brachiopoda*," which will appear in full in the forthcoming volume of the 'Philosophical Transactions.'

Many of Mr. Hancock's labours having been carried on conjointly with his friends Dr. Embleton and Mr. Alder, it is proper on this occasion that their merits should be duly acknowledged.

Of these conjoint papers may be more particularly noticed those upon the organization of Eolis and Doris, which are remarkable not only for the clear exposition they give of the previously much misunderstood structure of the genera in question, but are also important for the new and enlarged views they contain respecting many points in the economy of the Mollusca.

Together with these must also be mentioned the well-known 'Monograph on the British Nudibranchiate Mollusca,' in which Mr. Hancock was associated with Mr. Alder,—a work eminent alike for the beauty and fidelity of its illustrations, and the value and completeness of its zoological and anatomical details.

Among the more important of Mr. Hancock's numerous independent contributions to science, should be noticed a valuable paper on the "Excavating Powers of certain Sponges;" his discovery and accurate account of a new and curious genus of burrowing Cirripeds;

and several others, in all of which is manifested a remarkable capacity for minute and accurate observation conjoined with great powers of generalization.

But in none of Mr. Hancock's labours are these faculties so eminently displayed as in his more recent investigation of the organization of the Brachiopoda. In his elaborate monograph on this most difficult subject, and of which it may truly be said a more complete specimen of minute anatomy has not appeared since the time of Lyonet, a detailed account is given of the whole organization of the Brachiopoda founded upon the laborious dissection of numerous species; several interesting points in their economy first indicated by Prof. Huxley are confirmed; many additional facts communicated; and a new and clear light thrown upon the previously obscure subject of the physiological and systematic relations of the class in general.

Mr. Huxley,

In conveying this Medal to Mr. Hancock, assure him of the great interest we take in his valuable labours, and express our hope that he may be long enabled to prosecute inquiries, from which so much benefit to natural science may reasonably be anticipated.

Your Council have awarded the other Royal Medal to Mr. William Lassell, for his various astronomical discoveries and researches, and for his skilful construction of several large Reflecting Telescopes, with which such discoveries were made.

The first of these telescopes, having a speculum of nine inches in diameter, was erected at Starfield near Liverpool in the summer of 1840, from which time Mr. Lassell has been a most diligent and successful labourer in the field of astronomical science. Although none of the principal discoveries which entitle him to take rank with the leading astronomers of the day have been made with this instrument, still as this was the first large Reflector to which an equatorial mounting was applied, we are justified in looking upon its construction as an important step towards that eminence to which its maker has since attained.

This instrument, however, did not long satisfy Mr. Lassell, for in the year 1846 we find him observing with a 20-foot reflector with

an aperture of 2 feet, also equatorially mounted, which he had in the mean time constructed; and he soon announced the very important discovery, on the 10th of October, 1846, of a satellite of Neptune,—most important, as affording the means of ascertaining the mass of Neptune.

Great triumphs, however, were yet to come; in September 1848 he detected an eighth satellite of Saturn, and by a singular coincidence the same discovery was made simultaneously by Professor Bond in America.

To these manifold labours we have to add numerous observations of Satellites, and of Comets, Eclipses and other occasional phenomena.

Of this devotion to his favourite science Mr. Lassell has already received a recognition, which astronomers value most highly, viz. the Gold Medal of the Royal Astronomical Society, which was presented to him in February 1849; but this seems only to have stimulated his zeal for the further advancement of astronomical science.

In October 1851 our indefatigable observer established the existence of two satellites of Uranus, nearer to the planet than the first satellite of Sir William Herschel.

In the autumn of 1852 he conveyed his 20-foot reflector to Malta, principally in order to survey in a clearer atmosphere the systems of the three most distant planets, Saturn, Uranus, and Neptune, with which he has particularly identified himself. To use his own words,—"his discoveries abroad were rather negative than otherwise," for he was satisfied that without a great increase of optical power, no other satellite of Neptune would be discovered; and with regard to Uranus, he says,—"*I am fully persuaded that either he has no other satellites than the four, or if he has, they remain yet to be discovered.*"

In the summer of 1854, owing to the encroachment of buildings round Starfield, he was compelled to move two miles further into the country to Bradstones, and incur the expense of building a second observatory, and here his instruments are now erected.

His praiseworthy ambition still impelled him to become a leader, where other men are content to follow. In the prolonged discussions which arose relative to the mounting of the great reflector of 4 feet aperture for the observation of the Southern Nebulæ, Mr. Lassell

took an important and distinguished part; and with his characteristic and laudable energy and zeal in the cause of science, finding that such an instrument was just now a desideratum, he undertook to construct one at his own cost. This he has now completed. This splendid result of the well-applied industry and skill of one to whom Astronomical Science had been already indebted for two fine telescopes, has an aperture of 4 feet and 37 feet focal length, and this is also mounted equatorially. From this magnificent telescope, in the hands of such a man, what may not be expected? And it adds not a little to his merit, that all the specula for these several instruments have been cast by himself, and polished by a machine of his own contrivance, of which he has given a lucid description in the Memoirs of the Royal Astronomical Society; and the instruments themselves are mounted according to his own plans.

In conclusion, it will I think be generally allowed, and posterity will doubtless confirm the statement, that in the history of reflecting telescopes, the name of Lassell must rank with that of Herschel and that of our late President, Lord Rosse, whether we consider the talent and perseverance displayed in their construction, or the important discoveries which have resulted from their use.

MR. LASSELL,

In presenting this Medal, allow me to express a fervent hope that you may be endowed with health and a long life. Your previous labours are the best security that in that case the magnificent astronomical means now at your disposal will in due time contribute still further to enlarge the bounds of that science which you love so much and have so materially advanced.

On the motion of Sir Henry Holland, seconded by Sir Roderick Murchison, the best thanks of the Society were voted to the President for his excellent address, and his Lordship was requested to permit the same to be printed.

The Statutes relating to the election of Council and Officers having been read, and Admiral FitzRoy and Mr. Huxley having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were collected.

The following Noblemen and Gentlemen were reported duly elected Officers and Council for the ensuing year:—

President.—Sir Benjamin Collins Brodie, Bart., D.C.L.

Treasurer.—Major-General Edward Sabine, R.A., D.C.L.

Secretaries.— { William Sharpey, M.D.
George Gabriel Stokes, Esq., M.A., D.C.L.

Foreign Secretary.—William Hallows Miller, Esq., M.A.

Other Members of the Council.—Henry Wentworth Dyke Acland, M.D.; Admiral Sir George Back, D.C.L.; Rev. John Barlow, M.A.; Thomas Bell, Esq.; The Duke of Devonshire, M.A.; Edward Frankland, Ph.D.; John Peter Gassiot, Esq.; Philip Hardwick, Esq., R.A.; Arthur Henfrey, Esq.; Lieut.-Col. Henry James, R.E.; Sir Roderick Impey Murchison, M.A., D.C.L.; John Percy, M.D.; Archibald Smith, Esq., M.A.; Charles Wheatstone, Esq.; Rev. William Whewell, D.D.; The Lord Wrottesley, M.A.

The following Table shows the progress and present state of the Society with respect to the number of Fellows:—

	Patron and Honorary.	Foreign.	Having compounded.	Paying £2 12*s.* Anunally.	Paying £4 Annually.	Total.
December 1, 1857	9	48	374	8	276	715
Since elected	.....	+3	+9	.....	+8	+20
Re-admitted	.....	.....	.....	.....	.....	....
Since compounded	.....	.....	+1	.....	−1	....
Withdrawn	.....	.....	.....	.....	−1	− 1
Since deceased ..	.....	−1	−19	−1	−7	−28
November 30, 1858	9	50	365	7	275	706